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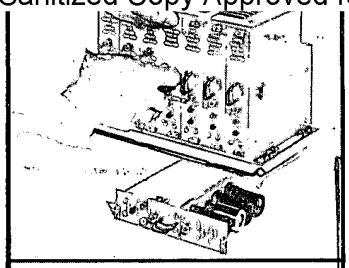
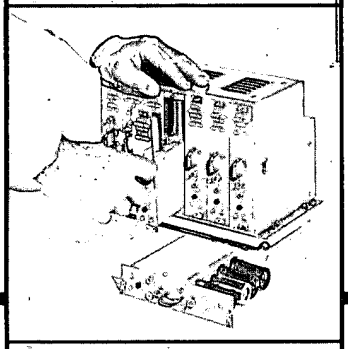
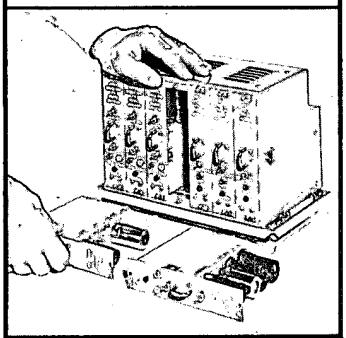
Section 2, pages 121 to 128.

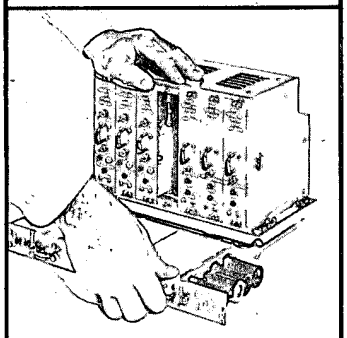
AMPEX [redacted] STAT

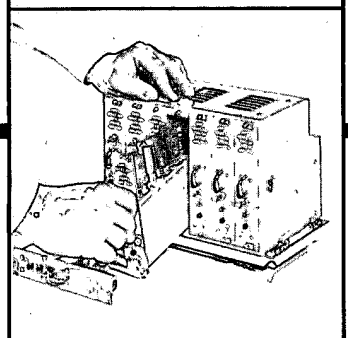
10-2 SERIES 800

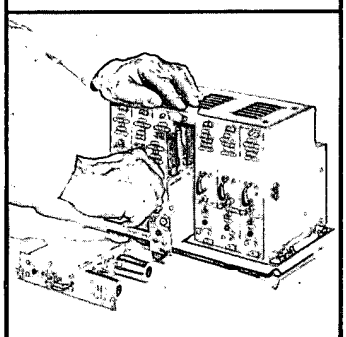




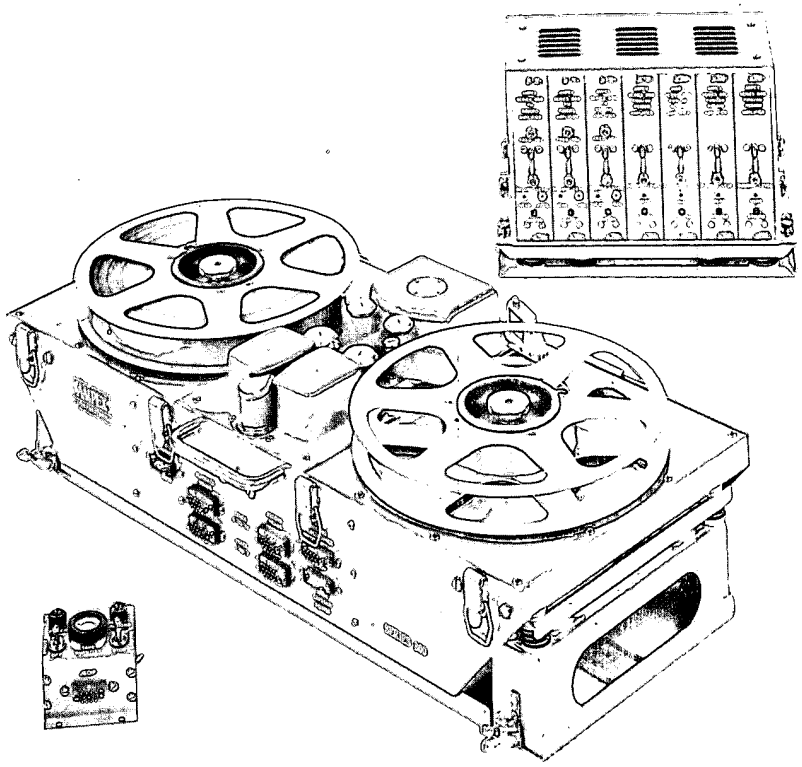








MULTI-CHANNEL
MAGNETIC TAPE RECORDERS



ENVIRONMENTAL RESISTANCE *to the conditions of airborne, shipboard and vehicular use.*

INTERCHANGEABLE AMPLIFIER UNITS *to encompass a maximum quantity, quality and variety of data.*

COMPATIBILITY *with Ampex instrumentation recorders presently in operation.*

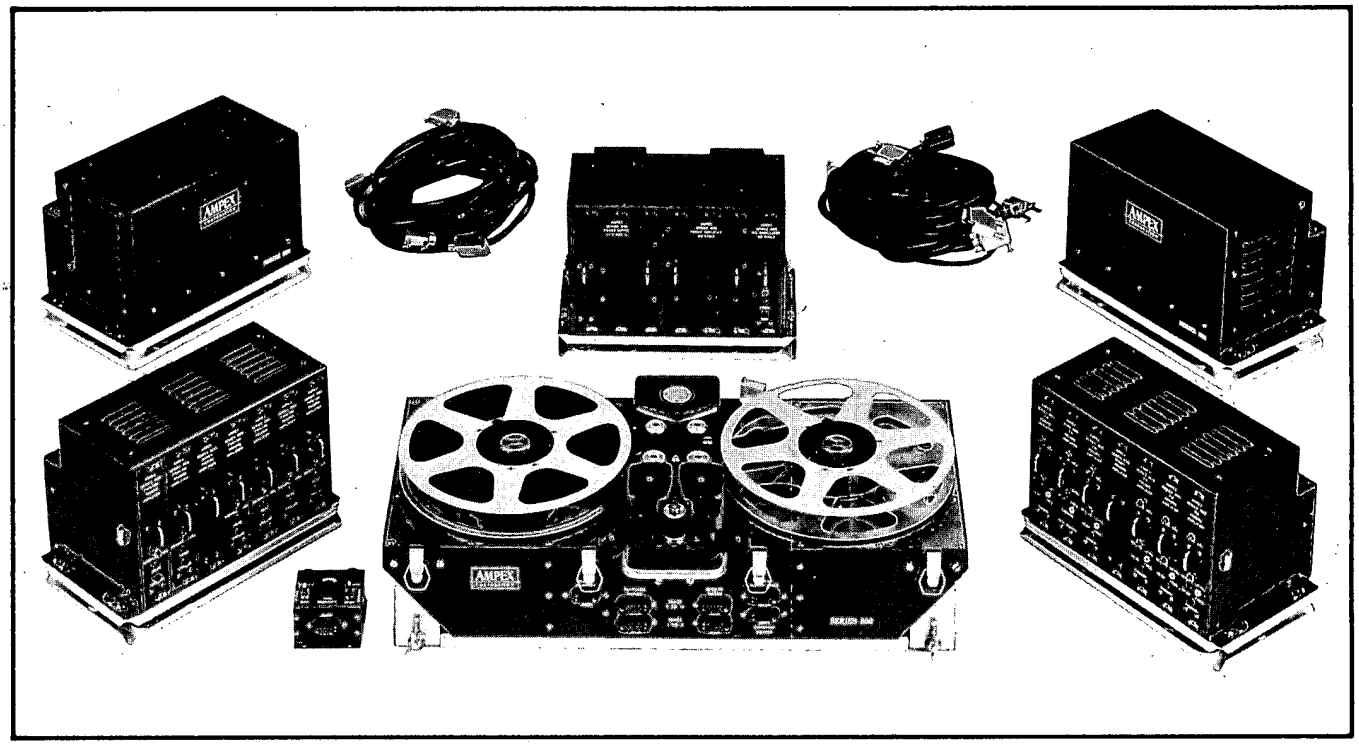
AMPEX SERIES 800

MULTI-CHANNEL MAGNETIC TAPE RECORDERS

The Ampex Series 800 equipment are compact, lightweight magnetic tape recorders designed for precise data recording under conditions encountered in airborne, shipboard and vehicular use. Under these environmental stresses, the Ampex 800 Recorders maintain a degree of precision heretofore expected only from machines operating under laboratory conditions.

The Ampex 800 equipment is able to record the broadest combination of data ever obtained concurrently on one magnetic tape. Various models are available with from 2 to 14 channels, and each channel can be quickly adapted to any recording need by interchangeable plug-in amplifiers. An added degree of flexibility is provided by four tape speeds, any one of which can be selected prior to the recording period.

Notwithstanding its excellent new features, the Ampex Series 800 retains compatibility. It does not obsolete the data and techniques already in use. Ampex machines of various other models now comprise the majority of all magnetic recorders in instrumentation service. Their recording characteristics, tape speeds, track widths and other parameters have become universal standards. The Ampex 800 retains these while greatly extending the environmental and mechanical conditions under which accurate test data can be gathered.



FEATURES

INTERCHANGEABLE CHANNELS — FM (frequency modulation) recording, direct recording or pulse width recording can be made available on any channel.

INTERCHANGEABLE SPEEDS — Tape transports are normally available with 30, 15, 7½, and 3¾ ips speed choice — or 15, 7½, 3¾, and 1⅞ ips speeds. (Other speeds available on special request.)

MEETS ALL ESSENTIAL FUNCTIONAL REQUIREMENTS OF MIL-E-5400 — Included are corrosion resistance, dust proof, high and low temperatures, high altitude, JAN type components and shock and vibration as noted below.

RESISTANCE TO SHOCK AND VIBRATION — Equipment will operate within specifications under vibrations up to ±10G. It will withstand shocks up to ±15G without damage (back page specifications give details).

LOW FLUTTER AND WOW — Closed loop design gives stability of tape velocity equal or superior to high quality laboratory tape transports in general usage. (See graph and explanatory notes on page 7.)

LIGHT WEIGHT AND COMPACT — A 7-channel Series 800 recorder weighs only 105 lbs. with its five functional units occupying approximately 2.5 cubic feet total.

REMOTE CONTROL — By intermittent operation of the start-stop control, the recording time can be limited to significant parts of the test, permitting one tape to cover a much longer elapsed time.

AMPEX
CORPORATION
MAGNETIC RECORDERS

WIDE RANGE DIRECT RECORDER

PRODUCT SPECIFICATION SHEET DS-3-1-3

934 CHARTER STREET • EMERSON 8-1471
REDWOOD CITY • CALIFORNIA

MODEL 307

Primarily designed to record all telemetering channels up to 70 KC, the Ampex Model 307 tape recorder is also well suited for recording many types of electrical information in the frequency range between 100 and 100,000 cycles. Developed from the 300 Series recorders and retaining all the features which make these Ampex machines the outstanding high-fidelity recorders in the audio field, the Ampex 307 contains necessary modifications to extend the frequency response out to 100 KC. These include a new electronic assembly, a special head assembly and transformer-free record and playback amplifiers. In addition, the units will operate at 15, 30 and 60 inches per second tape speed. Models having from one to fourteen separate data channels are available, making the 307 suitable for a wide variety of applications.

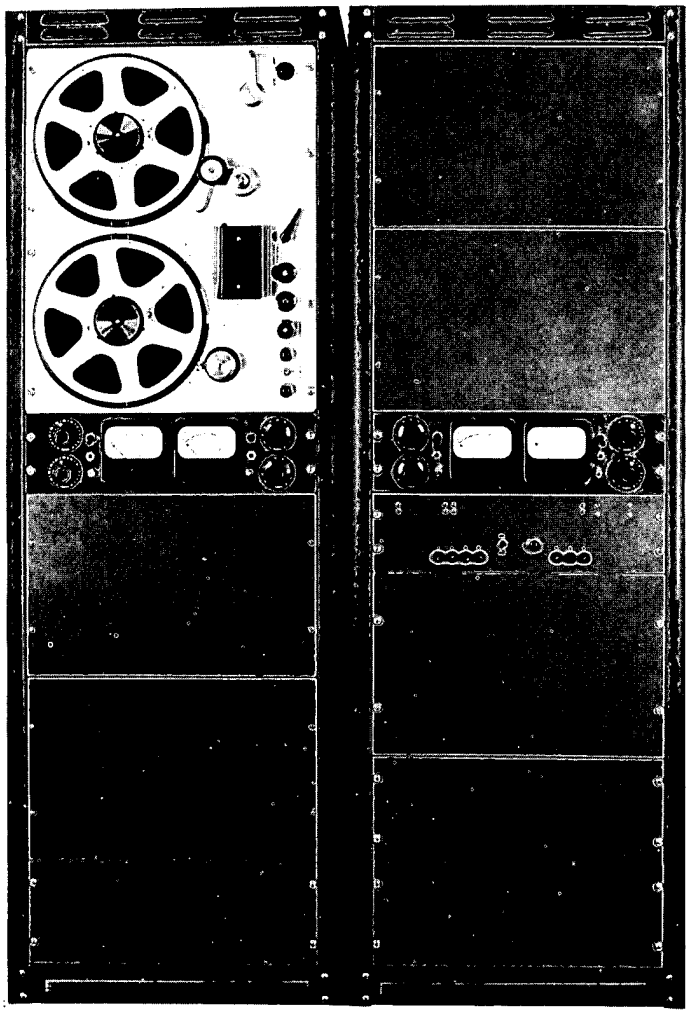


Fig. 1. Model 307-4, four-channel record and playback unit.

APPLICATIONS

Within its frequency range of 100 to 100,000 cycles, the Ampex 307 brings to many fields of scientific research and development these valuable inherent benefits of magnetic tape recording:

1. Data recorded on tape is permanently available in the same "live" electrical form in which it was recorded. This makes each playback effectively a rerun of the original test.

2. Not only can recorded data be reduced to any form that could have been made at the time of the original test but many entirely new methods of analysis and presentation are now possible.

3. Tapes can be scanned rapidly for location of critical information. They can also be slowed down, speeded up or played back in loop form for more complete interpretation. Without further processing, taped data can be fed into automatic reduction systems.

4. Magnetic tape can be played back repeatedly without any loss or deterioration in the accuracy of the recorded data.

5. Simultaneous recordings can be made of several events on one tape and these events can then be studied either individually or comparatively.

6. An extremely large amount of information can be stored at low cost on a small amount of tape.

7. Information obtained in the field can be reduced and analyzed at any time and any place under ideal laboratory conditions.

TELEMETERING — For recording data that is in frequency-modulated form, such as that encountered in FM/FM telemetering, the Ampex 307 is particularly effective. When used in the field of telemetering, the Ampex 307 stores all the multi-channel data transmitted during the entire flight by recording the *complete* output of the radio receivers. This eliminates the need for complex band-pass filter and discriminator systems previously required since tapes may be reproduced through a centrally-located ground station. Not only does this achieve great economy in receiving station installations but it notably simplifies the problem of analyzing the voluminous quantity of data associated with each missile flight by feeding it directly into automatic data reduction equipment. Because

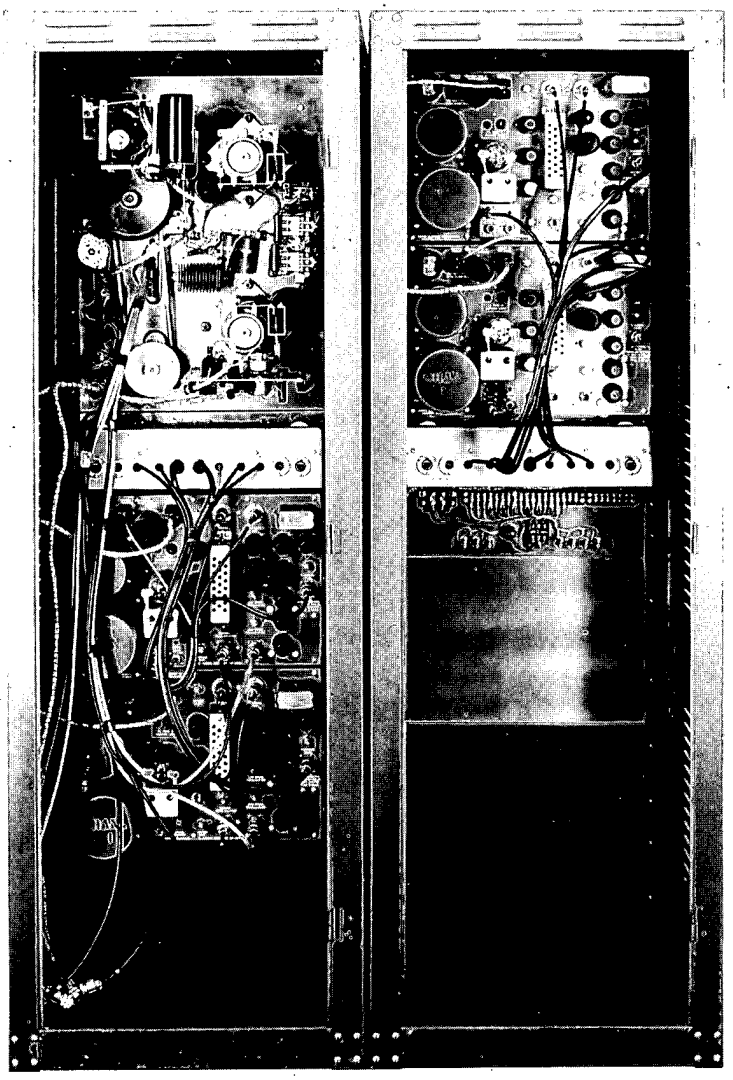


Fig. 2. Model 307-4, rear view.

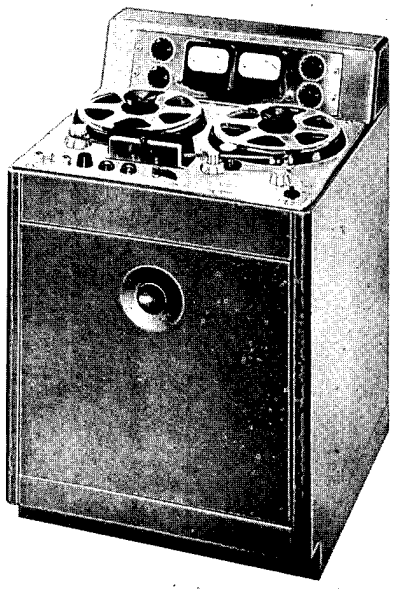


Fig. 3. Model 307-2, two-channel record and playback unit mounted in console cabinet.

magnetic recording produces an electrical output, recordings may be played directly, without further processing, into computers or analyzers, thereby eliminating the tedious, time consuming operation of reducing oscillograph traces.

GENERAL RESEARCH — The Ampex 307 is especially useful for determining steady-state values of recorded information, as when measuring the energy-versus-frequency distribution of vibration spectrums. In this application, steady-state amplitudes can be measured with an accuracy of ± 1 db. Its extremely wide frequency range also makes it highly desirable for recording very high frequency data. For special uses and requirements, various modifications of the basic 307 are available.

For low frequency or transient information whose accuracy might be affected by tape imperfections, a Model 306 carrier-type electronic chassis should be used with the Model 307. The Model 306 chassis may be connected directly to the heads, in which case the record head must be tuned with an 0.005 microfarad capacitor for 30 ips operation. The Model 306 record output can also be fed into the Model 307 record amplifier and the output of the 307 playback amplifier reproduced through the Model 306 demodulator.

With a few minor modifications, the basic equipment may be used as a continuous-loop playback system for detailed study and analysis of recorded data.

In these and many other ways, the Ampex 307 provides an accurate and convenient method of recording operating and test data with a range and fidelity unmatched by other types of recording instruments.

DESCRIPTION

The Ampex 307 is made up of the following assemblies:

1. A top-plate, which consists of the tape transport mechanism and includes:
   a. Operating controls
   b. A plug-in head assembly, containing the heads and the housing.
2. An electronic assembly which is made up of both record and playback amplifiers and the power and bias supplies.
3. A Power Distribution Panel for all models except 1 and 2-track units.

TOP-PLATE — The tape transport mechanism is essentially the same as the one used for the Ampex 300 Series audio recorders which has won an enviable reputation for smooth tape motion, dependability and timing accuracy. This stability of tape motion has been achieved by careful design of every component to minimize the effects of any potential sources of speed variation. Three motors are used,

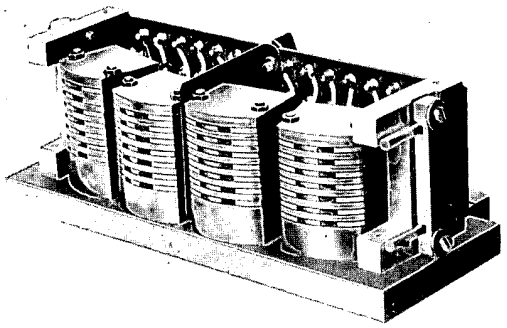


Fig. 4. 14-track record and playback head assembly, showing head stacks.

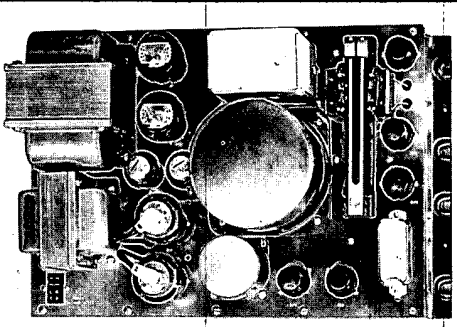


Fig. 5. Model 375, Precision 60-cycle Power Supply.

providing rugged, durable operation with minimum complexity of control and design. Two of these are high torque induction motors which drive the takeup and supply reels and maintain proper tape tension during normal play of the unit. These motors also provide fast tape speeds for Rewind and Fast Forward. Smooth capstan drive power is furnished by the third motor which is of the hysteresis synchronous type. If tape tension is removed for any reason, a Takeup Tension Arm actuates a switch which automatically stops the machine.

OPERATING CONTROLS—Start, Stop and Record are relay-operated by push-buttons located on the top-plate. Plug-in provisions have been included for remote operation of these controls. Normal Play, Fast Forward and Rewind are controlled by a rotary selector switch also located on the top-plate.

HEAD ASSEMBLY — The plug-in type head assembly contains separate record and playback heads. One and two-track units also include an erase head. This erase head is omitted from machines having 3 to 14 tracks, tank erasure being the usual method of erasing. On multi-track models, the heads are stacked one above the other and separated by shielding consisting of alternate layers of Mu-metal and copper.

a. Three and four-track units using ½-inch tape have the record heads in one stack and the playback heads in a second stack. Center-to-center track spacing is 0.140 inches.

b. Seven-track units designed for ½-inch tape have four record heads in one stack and the other three record heads in a second stack. The seven playback heads are similarly arranged. The tracks of the three-head stacks fit the gaps between the tracks of the four-head stacks. Center-to-center track spacing is, in this case, 0.070 inches.

c. Fourteen-track units using a one-inch tape have two seven-head record stacks and two seven-head playback stacks. The track arrangement is similar to that described in subparagraph b, above. See Fig. 4.

ELECTRONIC ASSEMBLY — The electronic assembly for a single track is mounted on a chassis which occupies 12¼ inches of standard relay rack space. It contains separate record and playback amplifiers and, in addition, includes the power supply as well as the erase and bias oscillator. Monitoring of the signal being recorded on the tape is a benefit gained by the use of separate amplifier circuits. So that each channel can operate completely independently from the others, one of the electronic assemblies just described is incorporated for each track, except that only one assembly contains an erase and bias oscillator. To provide record bias, the other electronic assemblies have bias buffer amplifiers driven by the erase-bias oscillator of the first track.

AC POWER DISTRIBUTION PANEL — An AC Power Distribution Panel is supplied with all multi-track recorders having over two tracks. It incorporates a switch, pilot light and fuses for the entire unit, together with the special cabling necessary for power distribution to each component. The panel occupies 5¼ inches of rack space in units with less than eight tracks, and 7 inches in units with eight or more tracks.

ACCESSORIES

MODEL 381 SPEED-LOCK — For data applications requiring extreme timing accuracy of reproduction, the Speed-Lock compensates for changes in tape dimension and drive speed differences which would otherwise cause a DC shift on the final data when recording FM/FM telemetering data. It does this by controlling the speed of playback to insure that reproduced data is an exact time replica of the original. The output of a tuning-fork amplifier is recorded as a reference frequency on one of the tracks during recording. During playback, this reference signal is compared to the standard. Any phase difference generates an error signal which adjusts the capstan motor speed to keep the frequencies matched. Correcting action is smooth and accurate so that at no time does the average reproduced frequency differ from the original by more than 0.02%.

MODEL 375 PRECISION 60-CYCLE POWER SUPPLY — For field locations where a stable source of 60-cycle power is not available, the Model 375 provides precise 60-cycle power for driving the capstan drive motor at constant speed. A receptacle and relay are provided in the top-plate for direct connection from this unit.

AUXILIARY EQUIPMENT (supplied with each unit)

- Two NARTB reels (empty).
- Reel hold-down assemblies:
  a. On portable or console models using ¼-inch tape — Reel editing knobs, Ampex Catalog No. 1917
  b. On rack-mounted models using ¼-inch tape — Reel hold-down knobs, Ampex Catalog No. 4402
  c. On all ½-inch and 1-inch tape models — Reel hold-down assemblies, Ampex Catalog No. 5881.
- A power cable.
- Mating input and output connectors.
- All required inter-unit connecting cables.
- Operation and Maintenance Manual.

MODEL 307

GENERAL PERFORMANCE CHARACTERISTICS AND SPECIFICATIONS

TAPE SPEED

30 and 60 inches per second. Changing between high and low speed is accomplished by a switch which also automatically provides for proper equalization.

15 inches per second tape speed is also available by simply removing a capstan sleeve. This change requires a change of equalization settings.

FREQUENCY RESPONSE

FOR SINGLE-TRACK RECORDERS:

60 inches per second:	*± 3 db, 200 to 80,000 cycles*
	± 10 db, 100 to 100,000 cycles
30 inches per second:	*± 3 db, 200 to 40,000 cycles*
	± 10 db, 100 to 50,000 cycles
15 inches per second:	*±3 db, 200 to 20,000 cycles*
	± 10 db, 100 to 30,000 cycles

FOR MULTI-TRACK RECORDERS:

60 inches per second:	*± 3 db, 300 to 70,000 cycles*
30 inches per second:	*± 3 db, 300 to 35,000 cycles*
15 inches per second:	*± 3 db, 300 to 15,000 cycles*

SIGNAL-TO-NOISE RATIO

Overall unweighted system wide-band noise is 55 db below tape saturation when recording with constant current in the record head within the specified pass band. The noise is essentially uniformly distributed across the spectrum so that use of band pass filters improves the signal-to-noise ratio accordingly. Tape saturation is approximately 20 db above the recommended operating level, the point of 1% total harmonic distortion as measured at any frequency in the pass band.

STARTING TIME

Approximately 5 seconds is required for stable tape motion at 15 and 30-inch tape speeds; approximately 10 seconds for stable motion at 60-inch speed with slow start. Fast start cannot be used at 60-inches per second; the change from fast start to slow start is made by a switch underneath the top plate.

STOPPING TIME

Approximately 10 inches of tape passes through the head housing after the Stop button is pressed at 60 inches per second.

FLUTTER AND WOW

Well under 0.1% rms, measuring all flutter components from 0 to 300 cycles, using a tone of 3,000 cycles.

REWIND TIME

One minute for full 10½-inch reel.

CONTROLS

Pushbutton controls are provided for Start, Stop and Record. A Jones-plug receptacle allows operation from a remote location. Normal Play, Fast Forward and Rewind are on a selector switch. Rapid shuttling back and forth is made possible by instantly changing from one mode of operation to the other without stopping in between.

PLUG-IN HEAD ASSEMBLY

One and two-track machines have erase, record and playback heads. Multi-track units over two tracks have no erase facility. Shielding of playback heads on units employing ¼-inch tape consists of double Mu-metal cans, with similar shielding on the record heads. On units with ½-inch or wider tape, physical considerations do not permit the use of individual head shield cans. The vertical alignment of the gaps in each head stack is held within ± 0.001 inch tolerance. AN type connectors are used to make head cable connections for each track.

MONITORING

Completely separate record and playback systems permit monitoring when recording.

HARMONIC DISTORTION

1% rms total harmonic distortion at the normal operating level.

INPUT

100,000 ohms unbalanced input. Adjusted for 1.23 volts rms for normal record operating level (+ 4 dbm).

OUTPUT

Adjusted for 1.23 volts rms into a 600-ohm load, unbalanced, for a normal operating level on the tape. The unit can be set for outputs up to 4 volts.

POWER REQUIREMENTS

Top-plate, 2½ amps.
Top-plate including Model 375 amplifier for capstan drive, 5 amps.
Electronic Chassis, 1¼ amps. per channel.

115 volt, 60-cycle power is standard.

115 volt, 50-cycle power drive is available.

RECORDING TIME

16 minutes for 2400-foot reel at 30 inches per second.

METER CONTROL PANELS

Meter Control Panels are available at extra cost. Engineering bulletin No. 3-1-3B contains the descriptions of various types.

DIMENSIONS AND MOUNTINGS

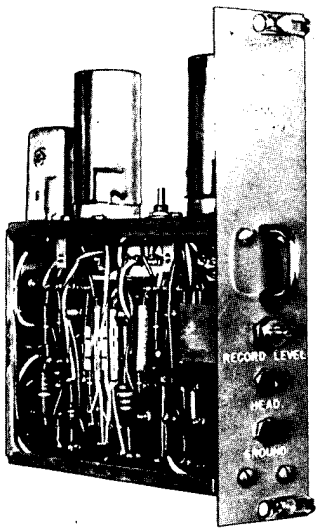
Dimensions and weights of all models are shown in the table below. All models are available for mounting in standard 19-inch relay racks. Models available in console cabinets or portable cases are indicated in the table.

Model Number	Recording Tracks	Rack Space	Weight*	Available as Portable**	Available as Console***
307-1	1	36¾"	100 lbs	2 cases	Yes
307-2	2	49"	133 lbs.	2 cases	Yes
307-3	3	57¾"	170 lbs.	3 cases	No
307-4	4	78¾"	203 lbs.	3 cases	No
307-5	5	91"	236 lbs.	4 cases	No
307-6	6	105"	269 lbs.	4 cases	No
307-7	7	115½"	302 lbs.	5 cases	No
307-14	14	203"	534 lbs.	No	No

**Weight is total for components. Shipping weight is approximately 155% of this weight. For portable and console units, weight of cabinet or cases must be added.*

***Portable cases (each) — 25½" high x 20" wide x 15¼" deep; weight 22 lbs.*

****Console cabinet — 36¼" high x 25¼" wide x 26" deep; weight 75 lbs.*



CHANNEL INTERCHANGEABILITY

This distinctive feature of the Ampex 800 allows an almost unlimited variety of data to be recorded concurrently. It makes the Ampex 800 a combination recorder of numerous combinations. It conserves channel space on the simpler data while reserving sufficient additional frequency spectrum for more complex recording problems. Two alternative modules plug in to any channel space on the Ampex 800 to provide three types of record amplifiers. One is an FM type. The other can be set either for direct recording or PWM, hence three recording characteristics are available as follows:

Pulse Width Modulation Recording
(like the Ampex 303)

By this technique a large number of low frequency data channels can be recorded together on one tape channel as a sequence of pulse durations. A rotating commutator (not a part of the 800) continuously scans any desired number of transducers (sometimes as many as 90). Their momentary voltages determine pulse durations between 90 microseconds (minimum voltage) and 660 microseconds (full scale). Frequency response has a direct relation to sampling rate (0 to 5 cps. for 30 data channels and a 900 sample per second rate).

FM Type Recording
(like the Ampex 306)

The recording of low frequencies and the recording of transients with high instantaneous accuracy are the advantages of this type of channel. Frequency response is from d-c to 5000 cps. at 30 ips. tape speed and is proportional at lower speeds. Data are recorded as a frequency modulation of a carrier wave, hence data amplitude is unaffected by variations in the tape.

Wide Frequency Direct Recording
(like the Ampex 307)

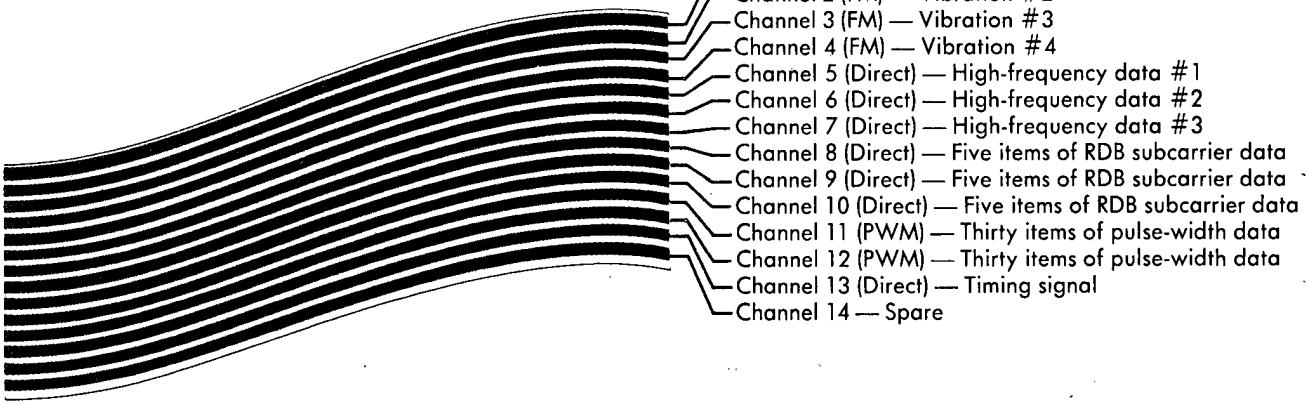
Frequency response is 300 to 35,000 cps. at 30 ips. tape speed. At lower speeds it is proportional. This broad response can be used for phenomena containing high-frequency components. More commonly, though, it is used for multiplexing data on RDB FM/FM subcarriers. This technique puts information from many separate data pickups onto one tape channel.

Data from these three types of recording can be reproduced on Ampex 306, 307 and 303 recorders respectively (or on 300-series combination recorders containing these channel characteristics in the proper positions).

AN EXAMPLE

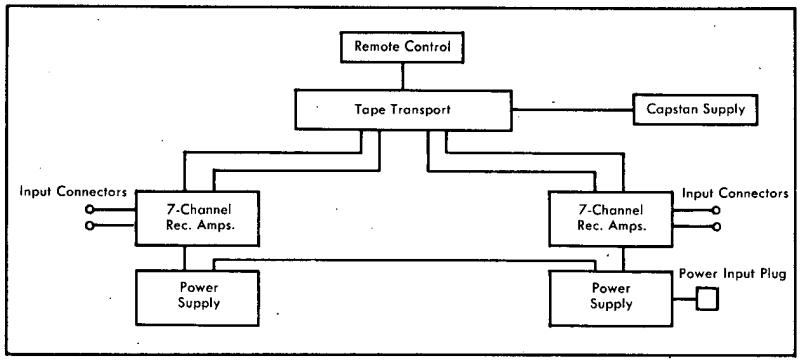
The problem — In the flight of an aircraft, the following data readings are desired: 4 items of vibration information that includes low-frequency information — 3 channels of high-frequency information — 15 channels of limited-frequency information that can be translated onto RDB subcarriers — 60 channels of quasi-static data such as temperatures, pressures, rate of flow, etc. which could be recorded by the pulse-width modulation technique.

The solution — A model 814 fourteen-channel recorder will record all of these data simultaneously by selection of the proper number of each type of amplifier.



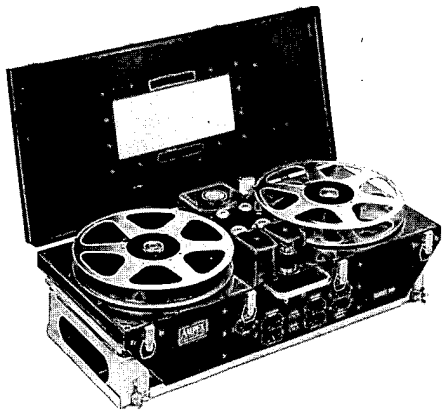
By this choice of channel characteristics, 82 separate data items were recorded simultaneously on one time base without restricting the frequency band width of those items that require a broad response.

DESCRIPTION



A complete Ampex Series 800 Recorder is comprised nominally of five interdependent sections connected by cables. They are the tape transport, record amplifier assembly, electronic power supply, capstan motor power supply and remote control unit. Recorders of 14-channel capacity will have two record amplifier assemblies and two electronic power supplies. The necessary component units can be placed in any positions relative to each other.

TAPE TRANSPORT



Tape transport shown with cover open

The most critical function of the tape transport is the maintenance of extremely constant tape velocity. Starting, stopping, supply, take-up and tape tension are necessary incidental functions.

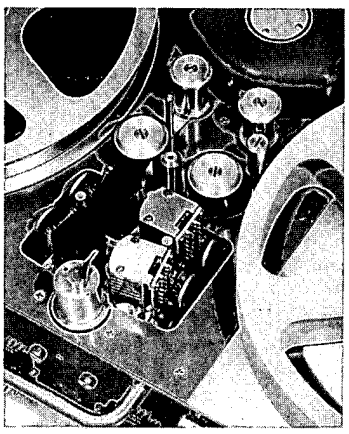
On the Ampex 800 the problem of maintaining constant tape velocity is compounded by weight reduction requirements and the likelihood of shock and vibration during operation. It does, nonethe-less, achieve a stability of tape motion equal to high quality laboratory-type tape recorders. This is achieved by utilizing a closed-loop design based on extensive Ampex experience. Tape moving past the heads is held tightly in a short closed loop between capstan and idlers. Shock mounting of the tape transport further reduces any external influences on tape motion.

The capstan, which meters the tape, is driven by a 60-cps hysteresis-synchronous motor coupled through pulleys by nylon belting. An a-c motor is used for this purpose, because no available d-c motor has sufficient speed stability. Speed of the motor is determined by 60-cps current derived from the capstan power supply. A-C power required is small, since the d-c takeup motor provides a substantial portion of the torque necessary to transport the tape.

Selection of any one of four operating speeds is accomplished by a simple manual change of the nylon drive belts. The Series 800 tape transport is inherently capable of operation at either 30, 15, 7½ and 3¾ ips. or 15, 7½, 3¾ and 1⅞ ips.

So that the start-stop functions may be controlled remotely by a single on-off switch, all operational control of the tape transport is by means of relays and solenoids. Also included in the drive mechanism is a tape rider providing automatic stop in the event of tape breakage or loss of proper tape tension.

To permit the Series 800 machines to operate to an ambient temperature of minus 65° F., heaters are provided in the top-plate unit. This is necessary primarily because of the temperature limitations of the magnetic tape itself.



Heads are located on the tape transport top-plate in the closed loop between capstan and idler

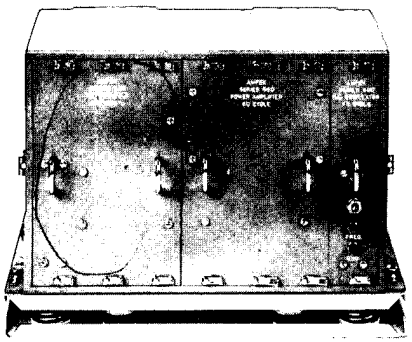
RECORD HEADS

To implement the use of plug-in interchangeable amplifiers, the 800-series record heads are universal to the three available recording characteristics. In addition, their track widths and center-to-center track spacings are compatible with the Ampex 300-series laboratory recorders.

To provide extreme accuracy of interchannel timing, gap alignment of all head assemblies is maintained to within ±0.00005 inch of an optical center-line.

All standard Series 800 heads use 0.050"-wide recording tracks. Track center-to-center spacing is 0.070" for ½" tape and 1" tape machines, and is 0.140" for the ¼" tape machines. Quarter-inch machines have a single stack with two heads. Half-inch 7-track machines have two interlaced stacks with four and three heads respectively. The one-inch 14-track machines have two stacks of seven each. Special heads can be provided upon request.

CAPSTAN MOTOR POWER SUPPLY



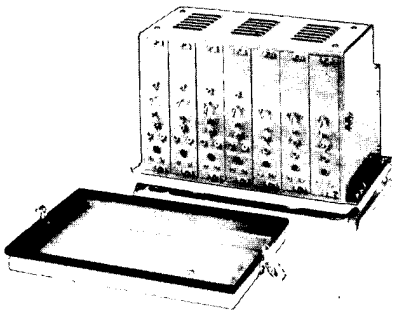
Capstan motor power supply

By controlling the capstan motor speed, this power supply determines tape speed very accurately. It consists of an oscillator of the Wien bridge type operating at 60 cps, a power amplifier with an output of 32 watts, and an integral power supply operating from a 115-volt 400-cps source. All are contained in a single shock-mounted case.

The oscillator will maintain the 60-cps frequency to within one part in four thousand under ordinary room ambient conditions and one part in one thousand throughout the ambient conditions given in the specifications. At the factory the 60-cps frequency of the oscillator is set under ordinary room conditions to within one part in ten thousand. A locking-type potentiometer and a test jack are provided for field adjustment should such become necessary.

RECORD AMPLIFIER ASSEMBLY

The record amplifiers and their housing have been designed to simplify the interchangeability feature and to function properly under the environmental conditions for which the Series 800 machines are recommended.



Record amplifier assembly with cover removed

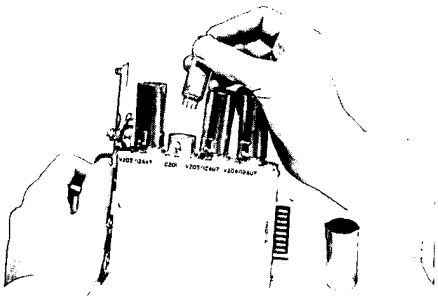
Housing

The record amplifier housing provides encasement, shock mounting, and all connections to seven plug-in record amplifiers. The housing is provided with a filtered air intake and blower. A latch-on front cover seals the record amplifier plug-in units from dust and moisture. On fourteen-track machines, two of these seven-unit housings are used.

FM Record Amplifiers

The FM record amplifier strip accomplishes three functions. A direct-coupled amplifier amplifies the incoming signal. A positive-grid free-running multivibrator generates a carrier which is frequency modulated by the amplified signal voltage. Then a further stage amplifies the frequency modulated carrier to a level that drives the tape to magnetic saturation. A maximum input signal of ± 1 volt rms (± 1.41 volts peak) deviates the center frequency $\pm 40\%$, which is specified as 100% modulation.

To enable the FM record amplifiers to operate at all the tape speeds available on Series 800 machines, the frequency-determining components of the multivibrator are contained within a small plug-in unit located in line with the amplifier tube envelopes. The amplifier normally will be furnished with only the one unit required for the operating speed specified in the customer's order. Additional frequency-determining plug-in components for the other speeds are available at nominal extra cost. A 27-kc center frequency is used at 30 ips with all others in direct proportion to tape speed.



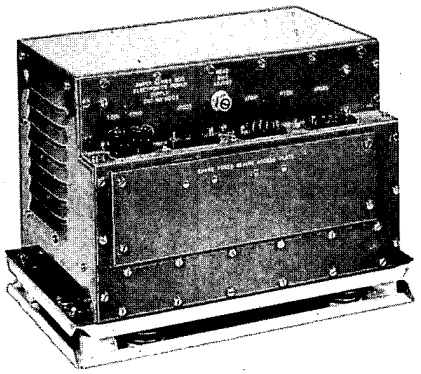
FM record amplifier unit showing removal of the frequency determining element

AM/PWM Record Amplifiers

These strips can be used either as an amplifier for direct recording (designated as AM for simplicity although technically it does not involve modulation) — or as a pulse-width modulated signal record amplifier (PWM). A switch on top of the amplifier chassis (behind the front panel) selects between AM and PWM positions. In the AM setting, the strip functions solely as an amplifier. It uses no equalization, hence requires no changes for different tape speeds. The amplifier response is uniform within $\pm \frac{1}{2}$ db. from 200 to 200,000 cps, but the actual high frequency response of the reproduced data is a function of the tape speed and is always much less (see specifications). The amplifier will record at normal tape level with an input signal of 0.15 volts rms or greater. The potentiometer on the front panel marked RECORD LEVEL is connected in the signal input circuit.

When the switch is in the PWM (pulse width modulations) position, clipping and differentiating circuits are included in the amplifier to produce positive and negative pips which sharply define the beginnings and endings of pulses. No adjustment is required for different tape speeds, but the sharpness of the pips changes proportionately and affects the quality and accuracy of information that can be recorded on each channel. Clipping is such that with the amplifier input level control in maximum gain position, any signal between 0.5 volts and 10 volts will be recorded correctly.

ELECTRONICS POWER SUPPLY

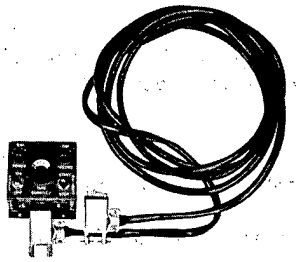


Rear view of electronic power supply

To accommodate the interchangeable amplifier feature of the Series 800 recorders, the electronics power and bias supply is universal. It can furnish all necessary plate and filament power to 7 channels of any combination of FM or AM/PWM types of record amplifiers. In addition, it contains a bias oscillator and amplifier supplying 400 kc bias current to as many as seven AM record channels. Plate voltages are regulated electronically. Filament voltage is regulated at 12.6 volts, 400 cps, by a magnetic amplifier type regulator.

Two electronics power supplies are required for a 14-channel recorder. However, only a single multi-pin plug and mating connector is required for power source input. An interconnecting cable between the two power supplies carries input power to the other power supply and synchronizes the bias current outputs. Each power supply is connected to a 7-unit record amplifier group by a separate cable.

REMOTE CONTROL UNIT

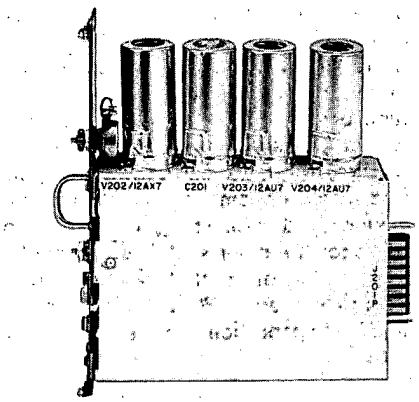


Remote control unit

The remote control unit makes it feasible to record data during a series of significant time intervals. It contains a power on-off switch and corresponding pilot light indicator, a record start-stop switch and corresponding pilot light indicator, and a meter showing the quantity of tape remaining on the supply reel.

Should the tape break or otherwise not be in proper tension in the tape transport, a tape rider arm automatically stops the transport (or will not allow it to start). In this event the pilot light indicator on the remote control unit will not light, regardless of the position of the record on-off switch.

ACCESSSORIES



Speedlock amplifier strip, FM/SP-LK

Model 800 test unit

PROVISIONS FOR SPEEDLOCK WITH SERIES 800 RECORDERS

Where accurate speed synchronization between the recorded and subsequently reproduced data are required, Speedlock can eliminate the effects of physical change in tape length, tape slippage or small differences in tape drive speed.

To accomplish this, an accurate 60-cps signal must be recorded on one tape channel. On the Series 800 Recorder, a 60-cps signal source is available in the form of the Wien Bridge Oscillator in the capstan motor power supply. Two alternate accessories are available for recording this signal on the tape.

The AM/SP-LK amplifier strip will replace a regular amplifier strip. It generates and amplitude modulates an 18.24-kc control track signal with the 60-cps signal. This is recorded on one track of the tape. Data may also be concurrently recorded through this same amplifier onto the same tape track provided none falls in the frequency band from 16.5 to 20 kc. This amplifier strip can only be used at tape speeds of 15 ips and greater.

The FM/SP-LK amplifier strip fits similarly into a regular amplifier space. It records an FM wave modulated by the 60-cps signal. It can be used at any tape speed, but no other data can be recorded on the same track. Used with the playback equipment, an Ampex Model 381 Speedlock makes a precise phase comparison between the reproduced 60-cps signal and an internal 60-cps frequency standard. It regulates the playback speed to keep the 60-cps signals in phase. The average phase-comparison error over a one minute period is less than .001%. Absolute timing accuracy is subject to frequency variations in the 60-cps standards and is approximately one part per thousand in the Wien Bridge Oscillator under the most severe operational environment of the Series 800 Recorder.

TEST UNIT

The Model 800 test unit is designed for alignment and checkout of the Model 800 recording system. It is light and entirely self-contained, requiring no external power source. It can be taken to the recording system wherever installed and connects to a 26-pin connector provided on the 800 electronic chassis. It can make a rapid, complete checkout of the following items:

D-C supply voltages—+28, +75, +150 and +250V d-c

A-C supply voltages—115V a-c 400 cycles and 12.6V a-c 400 cycles regulated.

FM carrier head current (RMS value)
Record bias head current
Record signal head current

Inclusion of a "Record" switch allows the operator to activate the record relays in the record amplifiers without the necessity of operating the normal "Record" switch on the control box. The test unit also includes convenient test points for connection to an oscilloscope for observation of head current wave-form and for connection to a frequency counter.

GENERAL PERFORMANCE CHARACTERISTICS AND SPECIFICATIONS

MODEL 800

PHYSICAL CHARACTERISTICS

TAPE SPEEDS — Standard machines may be operated at any one of four speeds in 1:2:4:8 ratio by manual belt and pulley changes. Standard speed range in any one tape transport is either 1⅞, 3¾, 7½ and 15 ips. or 3¾, 7½, 15, and 30 ips. Other combinations from 0.3 to 60 ips. are available on special order.

REEL SIZE — 10½-inch maximum.

NUMBER OF CHANNELS — Any number from 2 to 14. Channel arrangement is in alternate head stacks except 2-channel machines, which have only one head stack. Alignment between any two channels on one stack is better than 0.0001".

TRACK WIDTH AND SPACING — Track width is 0.050". Track spacing, center-to-center is as follows: On 807 and 814 machines — 0.070"; on 802 machines — 0.140"; on 804 machines — either 0.140 or 0.110 to be compatible with Ampex 307-4 or 500 respectively.

CONTROLS — Power switch and record switch on tape transport and remote control unit.

METERING FACILITIES — A 26-pin connector on the electronics chassis provides access to the following test voltages:

Head current for each of 7 amplifiers.
75, 150 and 250 volts, B+
12.6 V a-c heater voltage
115 volt, 400 cps primary power
28 volt d-c primary power
AM record bias
FM center frequency

Also, there is a head current test point on the front panel of each record amplifier. On FM amplifiers there is in addition an FM carrier test point.

INPUTS — **AM:** 0.15 volt rms, minimum, into 100,000 ohms shunted by 55 mmfd, unbalanced.
FM: 1 volt rms minimum, into 100,000 ohms, shunted by 55 mmfd, unbalanced.
PWM: 0.5 volt, zero to peak pulse minimum, at 100,000 ohms shunted by 55 mmfd, unbalanced.

PERFORMANCE

FREQUENCY RESPONSE — AM frequency response when played back through an Ampex Model 307:

Tape Speed	Response
1⅞ ips.	±3 db, 30 to 1875 cps.
3¾ ips.	±3 db, 30 to 3750 cps.
7½ ips.	±3 db, 30 to 7500 cps.
15 ips.	±3 db, 30 to 15,000 cps.
30 ips.	±3 db, 30 to 30,000 cps.

FM frequency response when played back through an Ampex Model 306:

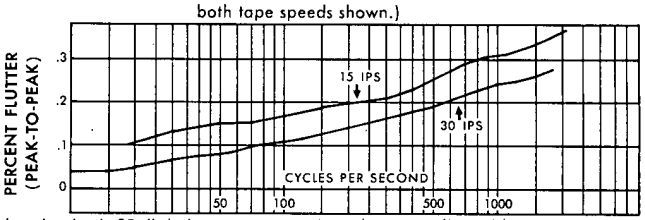
Tape Speed	Response
1⅞ ips.	+1, —3 db, 0 to 250 cps.
3¾ ips.	+1, —3 db, 0 to 500 cps.
7½ ips.	+1, —3 db, 0 to 1000 cps.
15 ips.	+1, —3 db, 0 to 2500 cps.
30 ips.	±½ db, 0 to 3000 cps.
	+1, —3 db, 0 to 5000 cps.

PWM frequency response when played back through an Ampex Model 303:

15 ips.	80 to 1000 microsecond pulse widths.
30 ips.	60 to 1000 microsecond pulse widths.

(The period of the pulse repetition rate must exceed the maximum pulse length by at least the minimum time above. Error will be less than 4 microseconds for both tape speeds shown.)

FLUTTER AND WOW — In improved tape transports flutter and wow have been reduced to approach both the limits of measuring instrument error and system noise. Hence, Ampex has developed special methods of measuring these parameters. Curves shown are based on their use.



SIGNAL-TO-NOISE RATIO — **AM:** Overall unweighted system wide-band noise is 55 db below tape saturation when recording with constant current in the record head within the specified pass band. Recommended operating level is approximately 20 db below tape saturation (at the point of 1% total harmonic distortion as measured at any frequency in the pass band).
FM: The rms noise level over the entire pass band is more than 40 db below the rms value of signal at maximum recording level (100 percent modulation).

CROSSTALK BETWEEN AM CHANNELS — Crosstalk is below the specified signal-to-noise ratio (i.e., over 55 db below tape saturation level), except when an AM channel is adjacent to an FM channel. Crosstalk pickup in the AM channel then deteriorates its signal-to-noise ratio as follows:

FM — **AM** — AM . . . . . 52 db below tape saturation.
FM — **AM** — FM . . . . . 49 db below tape saturation.

SPEED CHARACTERISTICS — The average velocity of the tape will be within ±0.2% of the specified tape speed under the environmental limits specified for the series 800 machines.

START AND STOP TIME — The tape reaches full speed within one second after operating the record control. Stable motion is reached within two seconds at all tape speeds. Less than five inches of tape are lost after the stop control is operated (at 30 ips).

RECORDING TIME (10½-inch reel)

Tape speed (ips.)	Acetate base tape	Mylar base tape (thin)
1⅞	4 hrs 16 min	6 hrs 24 min
3¾	2 hrs 8 min	3 hrs 12 min
7½	1 hr 4 min	1 hr 36 min
15	32 minutes	48 minutes
30	16 minutes	24 minutes

ENVIRONMENTAL LIMITS

SHOCK AND VIBRATION — With shock mounts attached the equipment will operate within its performance specifications for vibrations as follows:
10 to 55 cps., 0.060" double amplitude, ±10 g maximum;
5 to 500 cps., 0.010" double amplitude, ±5 g maximum.
The equipment will withstand without damage the following shock impacts: ±15 g for 11 ms — 18 impacts, 3 each plus and minus along each axis. The mounting frame will not fail for the following shock impacts: ±30 g for 11 ms — 6 impacts, one each plus and minus along each axis.

TEMPERATURE — Minus 65° F. to plus 130° F. at sea level. (Operation below 0° F. requires use of mylar tape.) Non-operating temperature range is —80° F. to 185° F., neglecting tape.

HUMIDITY — 100% relative humidity up to 50° C. (122° F.)

ALTITUDE — 3.4 inches of mercury (50,000 feet).

MODEL 800

GENERAL PERFORMANCE CHARACTERISTICS AND SPECIFICATIONS *(Continued)*

INPUT POWER REQUIREMENTS

TAPE TRANSPORT ONLY

27.5 volts d-c +10% —20%, at 2.9 amps.
115 volts a-c ±10%, 60 cps ±.05% at 0.3 amps.
115 volts a-c, 400 cps at 2 amps (intermittently for heaters).

The 115-volt, 60 cps current is furnished by the capstan motor power supply, if used.

CAPSTAN MOTOR POWER SUPPLY

115 volts a-c ±10%, 400 cps ± 20 cps at 1.3 amps.

ELECTRONIC POWER SUPPLY

115 volts a-c ±10%, 400 cps ±20 cps at 2.6 amps.
27.5 volts d-c +10% —20% at 0.6 amps.
The above figures are for one electronic power supply handling seven record amplifiers. On a 14-channel machine two electronic power supplies are required and input power requirements are double the above figures.

TOTAL SYSTEM REQUIREMENTS

Seven-channel recorder
115 volts a-c ±10%, 400 cps ±20 cps at 5.6 amps, 640 watts.
27.5 volts d-c +10% —20% at 3.5 amps, 95 watts.
Fourteen-channel recorder
115 volts a-c ±10%, 400 cps ± 20 cps at 8.2 amps, 940 watts.
27.5 volts d-c +10% —20% at 4.1 amps, 115 watts.

WEIGHT AND SIZE

TAPE TRANSPORT ASSEMBLY

25½" x 11⅜" x 6" — less shock mounting.
25½" x 11⅜" x 7" — including shock mounting and tape. Weight 48 pounds.

RECORD AMPLIFIER ASSEMBLY

The following is for 7 amplifiers in their housing. One such unit will be used for seven-channel machines and two for fourteen-channel machines.
7½" x 7¼" x 11" — less shock mounting. Weight 13 pounds.
7½" x 8⁹⁄₁₆" x 12⁹⁄₁₆" — including shock mounting. Weight 14 pounds.

ELECTRONIC POWER SUPPLY

One unit as follows for seven-channel machines, or two for fourteen-channel machines.
7½" x 7¼" x 11" — less shock mounting. Weight 16½ pounds.
7½" x 8⁹⁄₁₆" x 12⁹⁄₁₆" — including shock mounting. Weight 17½ pounds.

CAPSTAN MOTOR POWER SUPPLY

7½" x 7¼" x 11" — less shock mounting. Weight 19½ pounds.
7½" x 8⁹⁄₁₆" x 12⁹⁄₁₆" — including shock mounting. Weight 20½ pounds.

REMOTE CONTROL UNIT

3" x 1⅞" x 2⁹⁄₁₆". Weight ½ pound.

INTERCONNECTING CABLES

(1)	Power supply and electronics	6' 0" Max.	18 oz.
(2)	Electronics to transport	6' 0"	12 oz.
(3)	Transport to 60 cycle supply	7' 0"	7 oz.
(4)	Transport to remote control	13' 0"	11 oz.
(5)	Electronics to transport record heads	6' 0" Max.	24 oz.
(6)	Power supply to power supply (14-channel recorder only)	6' 0" Max.	17 oz.

ACCESSORIES AND OPTIONS TO SPECIFY

TAPE SPEED SELECTION

Standard tape transports can be ordered with either of two tape speed selections: 30, 15, 7½ and 3¾ ips., or 15, 7½, 3¾ and 1⅞ ips. Others from 0.3 to 60 ips. available on special order.

FACTORY SET TAPE SPEED

Tape speed at which the recorder will be used initially should be specified when ordering, so that the proper frequency-determining elements will be furnished in the FM record amplifiers.

CHANNELS

2, 7 and 14 channels are the basic 800-series designs, but intermediate numbers of channels may be ordered and will be furnished with blank panels in unused spaces in the amplifier assembly.

TRACK SPACING (Models 804 only)

On 804 machines track spacing should be specified according to the machine on which the tapes will be reproduced: 0.140 for reproduction on Ampex 307-4; 0.110 for reproduction on Ampex 500.

AMPLIFIER UNITS

Each channel can use either an FM or an AM/PWM type amplifier. The desired number of each should be specified in the order. Extra amplifiers should be ordered if in different recording situations it will be desired to vary the number of amplifiers of each type. Note that if a Speedlock amplifier is used, it displaces one AM or FM amplifier.

FM FREQUENCY DETERMINING ELEMENTS

If the recorder is to be used at tape speeds other than the one ordered at time of purchase, it will be necessary to have plug-in FM frequency-determining elements for each FM amplifier at each tape speed at which it will be used.

SPEEDLOCK PROVISIONS

If Speedlock is to be used during reproduction, one of two available Speedlock record amplifier units must be ordered:
AM/SP-LK, usable at 15 or 30-ips. tape speed permits the Speedlock channel to be used for data also.
FM/SP-LK for slower tape speeds (occupies an entire channel).

TEST UNIT

Test unit is an accessory and is furnished only if ordered. It is described on page 6.

ENGINEERING SERVICE

To provide further technical information beyond the scope of this bulletin and these specifications, the Ampex Instrumentation Division has a staff of application engineers. They are experienced in all phases and applications of magnetic tape recording techniques. For special problems they have ready access to all available technical information and engineering personnel. They are prepared to study your specific requirements and recommend techniques and equipment. Ampex also has technical representatives who will make personal calls anywhere in the United States. Your inquiry is welcomed.

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